1. Preface
2. The Periodic Table of Elements

Preface

Biology is designed for multi-semester biology courses for science majors. It is grounded on an evolutionary basis and includes exciting features that highlight careers in the biological sciences and everyday applications of the concepts at hand. To meet the needs of today's instructors and students, some content has been strategically condensed while maintaining the overall scope and coverage of traditional texts for this course. Instructors can customize the book, adapting it to the approach that works best in their classroom. Biology also includes an innovative art program that incorporates critical thinking and clicker questions to help students understand—and apply—key concepts.

Welcome to *Biology*, an OpenStax resource. This textbook was written to increase student access to high-quality learning materials, maintaining highest standards of academic rigor at little to no cost.

About OpenStax

OpenStax is a nonprofit based at Rice University, and it's our mission to improve student access to education. Our first openly licensed college textbook was published in 2012, and our library has since scaled to over 20 books for college and AP courses used by hundreds of thousands of students. Our adaptive learning technology, designed to improve learning outcomes through personalized educational paths, is being piloted in college courses throughout the country. Through our partnerships with philanthropic foundations and our alliance with other educational resource organizations, OpenStax is breaking down the most common barriers to learning and empowering students and instructors to succeed.

About OpenStax's Resources

Customization

upon the content, as long as you provide attribution to OpenStax and its content contributors.

Because our books are openly licensed, you are free to use the entire book or pick and choose the sections that are most relevant to the needs of your course. Feel free to remix the content by assigning your students certain chapters and sections in your syllabus, in the order that you prefer. You can even provide a direct link in your syllabus to the sections in the web view of your book.

Instructors also have the option of creating a customized version of their OpenStax book. The custom version can be made available to students in low-cost print or digital form through their campus bookstore. Visit your book page on openstax.org for more information.

Errata

All OpenStax textbooks undergo a rigorous review process. However, like any professional-grade textbook, errors sometimes occur. Since our books are web based, we can make updates periodically when deemed pedagogically necessary. If you have a correction to suggest, submit it through the link on your book page on openstax.org. Subject matter experts review all errata suggestions. OpenStax is committed to remaining transparent about all updates, so you will also find a list of past errata changes on your book page on openstax.org.

Format

You can access this textbook for free in web view or PDF through openstax.org, and in low-cost print and iBooks editions.

About Biology

Biology is designed to cover the scope and sequence requirements of a typical two-semester biology course for science majors. The text provides comprehensive coverage of foundational research and core biology concepts through an evolutionary lens. *Biology* includes rich features that engage students in scientific inquiry, highlight careers in the biological sciences, and offer everyday applications. The book also includes clicker questions to help students understand—and apply—key concepts.

Coverage and Scope

In developing *Biology*, we listened to hundreds of General Biology instructors who readily provided feedback about their courses, students, challenges, and hopes for innovation. The expense of textbooks and related items did prove to be a barrier to learning. But more importantly, these teachers suggested improvements for the textbook, which would ultimately lead to more meaningful and memorable learning experiences for students.

The result is a book that addresses a core organizational reality of the course and its materials—the sheer breadth of the topical coverage. We provide a thorough treatment of biology's foundational concepts while condensing selected topics in response to the market's request for a textbook with a scope that is manageable for instructors and students alike. We also strive to make biology, as a discipline, interesting and accessible to students. In addition to a comprehensive coverage of core concepts and foundational research, we have incorporated features that draw learners into the discipline in meaningful ways.

The pedagogical choices, chapter arrangements, and learning objective fulfillment were developed and vetted with the feedback of another one hundred reviewers, who thoroughly read the material and offered detailed critical commentary.

> Unit 1: **The Chemistry of Life**. Our opening unit introduces students to the sciences, including the scientific method and the fundamental concepts of chemistry and physics that provide a framework within which learners comprehend biological processes.

Unit 2: **The Cell**. Students will gain solid understanding of the structures, functions, and processes of the most basic unit of life: the cell.
Unit 3: **Genetics**. Our comprehensive genetics unit takes learners from the earliest experiments that revealed the basis of genetics through the intricacies of DNA to current applications in the emerging studies of biotechnology and genomics.
Unit 4: **Evolutionary Processes**. The core concepts of evolution are discussed in this unit with examples illustrating evolutionary processes. Additionally, the evolutionary basis of biology reappears throughout the textbook in general discussion and is reinforced through special call-out features highlighting specific evolution-based topics.
Unit 5: **Biological Diversity**. The diversity of life is explored with detailed study of various organisms and discussion of emerging phylogenetic relationships. This unit moves from viruses to living organisms like bacteria, discusses the organisms formerly grouped as protists, and devotes multiple chapters to plant and animal life.
Unit 6: **Plant Structure and Function**. Our plant unit thoroughly covers the fundamental knowledge of plant life essential to an introductory biology course.
Unit 7: **Animal Structure and Function**. An introduction to the form and function of the animal body is followed by chapters on specific body systems and processes. This unit touches on the biology of all organisms while maintaining an engaging focus on human anatomy and physiology that helps students connect to the topics.
Unit 8: **Ecology**. Ecological concepts are broadly covered in this unit, with features highlighting localized, real-world issues of conservation and biodiversity.

Pedagogical Foundation and Features

Biology is grounded in a solid scientific base, with features that engage the students in scientific inquiry, including:

Evolution Connection features uphold the importance of evolution to all biological study through discussions like “The Evolution of Metabolic Pathways” and “Algae and Evolutionary Paths to Photosynthesis.”
Scientific Method Connection call-outs walk students through actual or thought experiments that elucidate the steps of the scientific process as applied to the topic. Features include “Determining the Time Spent in Cell Cycle Stages” and “Testing the Hypothesis of Independent Assortment.”
Career Connection features present information on a variety of careers in the biological sciences, introducing students to the educational requirements and day-to-day work life of a variety of professions, such as microbiologist, ecologist, neurologist, and forensic scientist.
Everyday Connection features tie biological concepts to emerging issues and discuss science in terms of everyday life. Topics include “Chesapeake Bay” and “Can Snail Venom Be Used as a Pharmacological Pain Killer?”

Art and Animations That Engage

Our art program takes a straightforward approach designed to help students learn the concepts of biology through simple, effective illustrations, photos, and micrographs. *Biology* also incorporates links to relevant animations and interactive exercises that help bring biology to life for students.

Art Connection features call out core figures in each chapter for student study. Questions about key figures, including clicker questions that can be used in the classroom, engage students’ critical thinking to ensure genuine understanding.
Link to Learning features direct students to online interactive exercises and animations to add a fuller context to core content.

Additional Resources

Student and Instructor Resources

We've compiled additional resources for both students and instructors, including Getting Started Guides, an instructor solution manual, supplemental test items, and PowerPoint slides. Instructor resources require a verified instructor account, which can be requested on your openstax.org log-in. Take advantage of these resources to supplement your OpenStax book.

Partner Resources

OpenStax Partners are our allies in the mission to make high-quality learning materials affordable and accessible to students and instructors everywhere. Their tools integrate seamlessly with our OpenStax titles at a low cost. To access the partner resources for your text, visit your book page on openstax.org.

About the Authors

Senior Contributing Authors

Yael Avissar (Cell Biology), Rhode Island College
Jung Choi (Genetics), Georgia Institute of Technology
Jean DeSaix (Evolution), University of North Carolina at Chapel Hill
Vladimir Jurukovski (Animal Physiology), Suffolk County Community College
Robert Wise (Plant Biology), University of Wisconsin, Oshkosh
Connie Rye (General Content Lead), East Mississippi Community College

Contributing Authors and Reviewers

Julie Adams, Aurora University
Summer Allen, Brown University
James Bader, Case Western Reserve University
David Bailey, St. Norbert College
Mark Belk, Brigham Young University
Nancy Boury, Iowa State University

Lisa Bonneau, Metropolitan Community College – Blue River
Graciela Brelles-Marino, California State University Pomona
Mark Browning, Purdue University
Sue Chaplin, University of St. Thomas
George Cline, Jacksonville State University
Deb Cook, Georgia Gwinnett College
Diane Day, Clayton State University
Frank Dirrigl, The University of Texas Pan American
Waneene Dorsey, Grambling State University
Nick Downey, University of Wisconsin La Crosse
Rick Duhrkopf, Baylor University
Kristy Duran, Adams State University
Stan Eisen, Christian Brothers University
Brent Ewers, University of Wyoming
Myriam Feldman, Lake Washington Institute of Technology
Michael Fine, Virginia Commonwealth University
Linda Flora, Delaware County Community College
Thomas Freeland, Walsh University
David Grisé, Texas A & M University – Corpus Christi
Andrea Hazard, SUNY Cortland
Michael Hedrick, University of North Texas
Linda Hensel, Mercer University
Mark Kopeny, University of Virginia
Norman Johnson, University of Massachusetts Amherst
Grace Lasker, Lake Washington Institute of Technology; Walden University
Sandy Latourelle, SUNY Plattsburgh
Theo Light, Shippensburg University
Clark Lindgren, Grinnell College
James Malcolm, University of Redlands
Mark Meade, Jacksonville State University
Richard Merritt, Houston Community College
James Mickle, North Carolina State University
Jasleen Mishra, Houston Community College
Dudley Moon, Albany College of Pharmacy and Health Sciences
Shobhana Natarajan, Brookhaven College
Jonas Okeagu, Fayetteville State University
Diana Oliveras, University of Colorado Boulder

John Peters, College of Charleston
Joel Piperberg, Millersville University
Johanna Porter-Kelley, Winston-Salem State University
Robyn Puffenbarger, Bridgewater College
Dennis Revie, California Lutheran University
Ann Rushing, Baylor University
Sangha Saha, City College of Chicago
Edward Saiff, Ramapo College of New Jersey
Brian Shmaefsky, Lone Star College System
Robert Sizemore, Alcorn State University
Marc Smith, Sinclair Community College
Frederick Spiegel, University of Arkansas
Frederick Sproull, La Roche College
Bob Sullivan, Marist College
Mark Sutherland, Hendrix College
Toure Thompson, Alabama A&M University
Scott Thomson, University of Wisconsin – Parkside
Allison van de Meene, University of Melbourne
Mary White, Southeastern Louisiana University
Steven Wilt, Bellarmine University
James Wise, Hampton University
Renna Wolfe
Virginia Young, Mercer University
Leslie Zeman, University of Washington
Daniel Zurek, Pittsburg State University
Shobhana Natarajan, Alcon Laboratories, Inc.

The Periodic Table of Elements